CLAIMS

1. An insect acetylcholinesterase, characterized in that it comprises a central catalytic region which has an amino acid sequence selected from the group consisting of the sequence SEQ ID NO 1 and the sequences exhibiting at least 60% identity or 70% similarity with the sequence SEQ ID NO 1, with the exclusion of the acetylcholinesterase of NCBI sequence AAK0973.

2. The insect acetylcholinesterase as claimed in claim 1, characterized in that it includes a mutation of the glycine located at position 119, to serine, with reference to the sequence of the *Torpedo californica* acetylcholinesterase (SWISSPROT P04058).

3. The acetylcholinesterase as claimed in claim 1 or claim 2, characterized in that it corresponds to that of an insect of the family *Culicidae*, chosen from the genera *Culex*, *Aedes* and *Anopheles*.

4. The acetylcholinesterase as claimed in claim 3, characterized in that it is sensitive to insecticides of the organophosphorus compound and carbamate class, and in that it has a sequence selected from the group consisting of:

- the sequences SEQ ID NO 3, SEQ ID NO 5, SEQ ID NO 126 of *Anopheles gambiae*,
- the sequence SEQ ID NO 7 of *Culex pipiens* (strain S-LAB), and
- the sequences comprising a central catalytic region as defined in claim 1,

which sequences have a glycine at position 119, with reference to the sequence of the *Torpedo californica* acetylcholinesterase (SWISSPROT P04058), included in a fragment of sequence SEQ ID NOs. 91, 92, 96, 102 to 112, 114, 115 and 117 to 119.

5. The acetylcholinesterase as claimed in claim 3, characterized in that said central catalytic

region comprises a sequence selected from the group consisting of the sequences SEQ ID NOs. 8 to 21.

6. The acetylcholinesterase as claimed in claim 2 or claim 3, characterized in that it is resistant to insecticides and in that it has a sequence selected from the group consisting of the sequences SEQ ID NO 57 and SEQ ID NO 122 and the sequences comprising a fragment of sequence SEQ ID NOs. 90, 93, 94, 95, 97 to 101, 113 and 116 representing a peptide fragment of approximately 150 amino acids encoded by the third coding exon of the *ace-1* gene of a resistant insect as defined above, containing the substitution of G119S type, with reference to the sequence of *Torpedo californica* AChE (SWISSPROT P04058).

7. The acetylcholinesterase as claimed in claim 3, characterized in that said central catalytic region comprises a sequence selected from the group consisting of the sequences SEQ ID NOs. 90, 93, 94, 95, 97 to 101, 113 and 116.

8. A peptide, characterized in that it consists of a fragment of at least 7 amino acids of the acetylcholinesterase as claimed in any one of claims 1 to 7.

9. An isolated nucleic acid molecule, characterized in that it has a sequence selected from the group consisting of:

- the sequences encoding an acetylcholinesterase as claimed in any one of claims 1 to 7 (cDNA and genomic DNA fragment corresponding to the *ace-1* gene,
- the sequences complementary to the above sequences, which may be sense or antisense, and
- the fragments of at least 8 bp, preferably of 15 bp to 500 bp, of the above sequences.

10. The nucleic acid molecule as claimed in claim 9, characterized in that it is selected from the group consisting of:

a) the sequences SEQ ID NO 2, SEQ ID NO 4, SEQ ID NO 125, SEQ ID NO 6, SEQ ID NO 56 and SEQ ID NO 121 which correspond to the cDNA of the AChE1 protein of amino acid sequence, respectively, SEQ ID NO 3, SEQ ID

NO 5, SEQ ID NO 126, SEQ ID NO 7, SEQ ID NO 57 and SEQ ID NO 122, as defined above,

b) the sequences SEQ ID NO 22, SEQ ID NO 23 and SEQ ID NO 127 which correspond to the *ace-1* gene of *Anopheles gambiae* encoding the AChE1s as defined in claim 4, and

c) the sequences comprising the sequence SEQ ID NO 120 which corresponds to the virtually complete sequence of the *ace-1* gene of *Anopheles gambiae* encoding the resistant AChE1 of sequence SEQ ID NO 122, as defined in claim 5.

11. The nucleic acid molecule as claimed in claim 9, characterized in that it is selected from the group consisting of the primers of sequence SEQ ID NOs. 39 to 50, 54, 55, 58, 59, 123, 124, 128 and 129 and the fragments of sequences SEQ ID NOs. 24 to 38 and 60 to 89.

12. A method for detecting insects carrying resistance to insecticides of the organophosphorus compound and carbamate class, characterized in that it comprises:

- preparing a sample of nucleic acids from insects to be tested, and

- detecting, by any suitable means, the presence, in said nucleic acid sample, of a mutation in the *ace-1* gene as defined in claim 9 or in claim 10.

13. The method as claimed in claim 12, characterized in that said detection comprises:

- amplifying a fragment of approximately 320 bp using the pair of primers SEQ ID NOs. 39 and 40,

- digesting said fragment using a suitable restriction enzyme, and

- analyzing the restriction profile obtained.

14. The method as claimed in claim 13, characterized in that said restriction enzyme is *EcoRI*.

15. The method as claimed in claim 12, characterized in that said detection comprises:

- amplifying a fragment of approximately 520 bp using the pair of primers SEQ ID NOs. 58 and 59,

- digesting said fragment using a suitable restriction enzyme, and

- analyzing the restriction profile obtained.

16. The method as claimed in claim 12, characterized in that said detection comprises:

- amplifying a fragment of approximately 541 bp using the pair of primers SEQ ID NOs. 123 and 124,

- digesting said fragment using a suitable restriction enzyme, and

- analyzing the restriction profile obtained.

17. The method as claimed in claim 12, characterized in that said detection comprises:

- amplifying a fragment of approximately 194 bp using the pair of primers SEQ ID NOs. 128 and 129,

- digesting said fragment using a suitable restriction enzyme, and

- analyzing the restriction profile obtained.

18. The method as claimed in any one of claims 15 to 17, characterized in that said restriction enzyme is *Alu I*.

19. A recombinant vector, characterized in that it comprises an insert selected from the group consisting of the nucleic acid molecules as claimed in any one of claims 9 to 11.

20. A cell, characterized in that it is modified with a recombinant vector as claimed in claim 19.

21. An antibody, characterized in that it is directed against the acetylcholinesterase as claimed in any one of claims 1 to 7 or the peptide as claimed in claim 8.

22. A reagent for detecting insects carrying resistance to insecticides of the organophosphorus compound and carbamate class, characterized in that it is selected from the group consisting of the nucleic acid molecules and the fragments thereof as claimed in any one of claims 9 to 11 and the antibodies as claimed in claim 21.

23. A transgenic invertebrate animal, characterized in that it contains cells transformed with at

least one nucleic acid molecule as claimed in claim 9 or claim 10.

24. A method for screening an insecticidal substance, characterized in that it comprises:

a) bringing the test substance into contact with an acetylcholinesterase as claimed in any one of claims 1 to 7, or an extract of modified cells as defined in claim 20, or a biological sample from a transgenic animal as defined in claim 23, in the presence of acetylcholine or of one of its derivatives,

b) measuring, by any suitable means, the acetylcholinesterase activity of the mixture obtained in a), and

c) selecting the substances capable of inhibiting said activity.

25. A method for screening insecticidal substances, characterized in that it comprises:

- bringing a test substance into contact with a transgenic animal as claimed in claim 23, and

- measuring the animal's survival.

26. A reagent for screening insecticidal substances, characterized in that it is selected from the group consisting of the acetylcholinesterases as claimed in any one of claims 1 to 7, the recombinant vectors as claimed in claim 18, the modified cells as claimed in claim 20 and the transgenic animals as claimed in claim 23.

27. A detection and/or screening kit, characterized in that it includes at least one reagent as claimed in claim 22 or claim 26.

28. A method for screening inhibitors of an AChE1 as claimed in any one of claims 1 to 7, characterized in that it comprises:

(a) identifying molecules having a significant probability of binding to said AChE1;

(b) isolating the potential inhibitors identified in step (a);

(c) bringing the substance isolated in step (b) into contact with an AChE1 as claimed in any one of

claims 1 to 7, an extract of modified cells as defined in claim 20, a biological sample from a transgenic animal as defined in claim 23, or an extract of an insect sensitive or resistant to insecticides of the organophosphorus compound and carbamate class, in the presence of acetylcholine or of one of its derivatives;

(d) measuring, by any suitable means, the acetylcholinesterase activity of the mixture obtained in (c); and

(e) verifying that the molecules isolated in (b) inhibit the AChE1 activity.